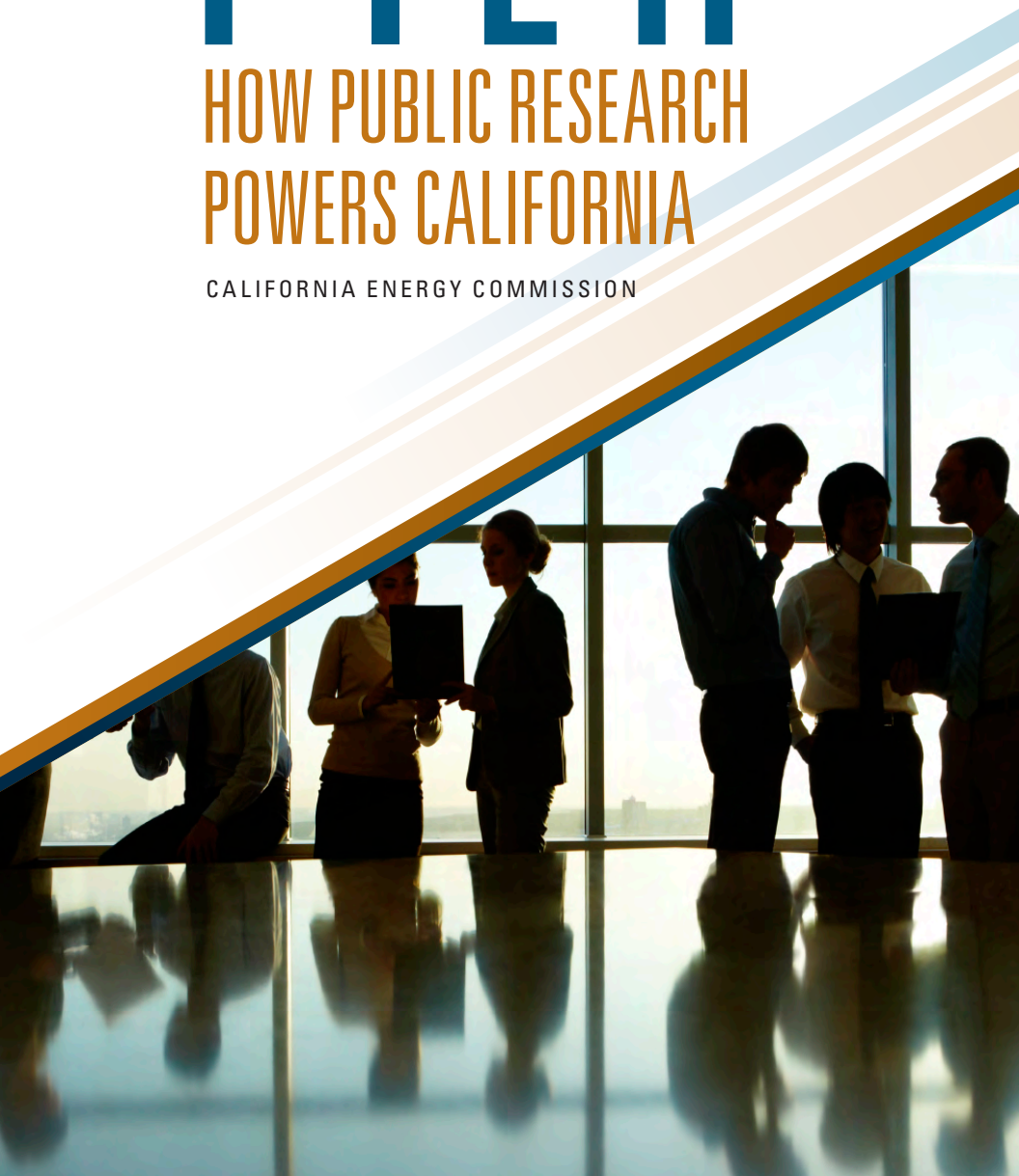
PIER

HOW PUBLIC RESEARCH POWERS CALIFORNIA

CALIFORNIA ENERGY COMMISSION



Californians spend almost $100 billion each year on energy

CALIFORNIA: AN ENERGY NATION

One in eight Americans lives in the Golden State. With nearly 38 million residents, Californians spends almost $100 billion each year on energy – electricity to power its homes, businesses and industry; natural gas for generating electricity, heating homes and powering industrial processes; and petroleum to run its cars, trucks, buses, trains and airplanes.

More than 80 percent of the energy consumed in California comes from two fossil fuel sources – petroleum and natural gas, and both are heavily imported from outside the state. To protect itself from shortages, California has adopted a policy of diversifying its energy supply. That's why today California receives more of its electricity from renewable resources like wind, solar and geothermal than any other state, and why the state plans to generate a third of its electricity from renewable sources by 2020. By that same year California plans to replace 20 percent of the petroleum used for transportation with sustainable fuels as well, and to roll back greenhouse gas emissions to 1990 levels. Achieving these goals will require creativity and innovation – the core qualities of a public interest energy research program.

With $21 million PIER has brought in $70 dollars for every $1 that California invested in its energy future

ABOUT PIER

The Public Interest Energy Research Program – PIER.

Since it began at the California Energy Commission in 1996, PIER has invested more than $700 million in energy research, development and demonstration projects with millions in tangible ratepayer benefits. PIER has also attracted more than $510 million in federal and private funding to California over the last decade (not including monies from the American Recovery and Reinvestment Act (ARRA). PIER funds complement and support private research and development – they are not a substitute for private research.

In 2010 alone, PIER's investment of $21 million in research funding was matched with more than $500 million in federal stimulus funding from the ARRA. It also leveraged more than $900 million in private venture funding – bringing in $70 dollars for every $1 that California invested in its energy future.

The results from PIER investment continue to save money, reduce energy demand, increase energy reliability and security, leverage ratepayer dollars, protect energy resources, environment and public health and provide a better California quality of life.

WHY PUBLIC RESEARCH?

Public Research Benefits the Public

PIER ensures that the ratepayers are the primary beneficiary of all public research investments. By focusing on *public interest* research, PIER explores new ideas that generate benefits for the general public, ideas that may not be reflected in the private market.

PIER fills a vital role by taking the long view on energy policy and by having higher risk thresholds to help fill research gaps needed to reach those goals. And since the results of PIER's research are publicly available to all at no charge – not proprietary like private research – they foster entrepreneurship and further innovation. *Public research* helps leverage other RD&D investments to achieve the greatest benefit to California's ratepayers.

PIER Integrates Research with Energy Policy

California energy policy requires significant reduction in greenhouse gas emission (AB 32) and a third of our state's electricity will be generated from renewable resources by 2020. PIER provides essential solutions to help meet these energy, economic and environmental quality goals and resolve technology barriers. PIER assures that research priorities and projects are aligned with state goals on energy efficiency, renewable energy and the environment.

Public-Private Partnerships Contribute to Project Successes

The Energy Commission has successfully guided PIER projects and products providing a balanced approach to allocating research funding that closely follows energy policies and directives. Creating and sustaining partnerships with small businesses, universities, California-based national research laboratories, utilities, energy companies and others helps leverage RD&D investments which are essential to performing the right research for the greatest benefit to California's ratepayers.

Open and Transparent Research Results

PIER ensures all research results and information are transparent, open and coordinated, helping to eliminate duplication, and making certain the results are publicly available and can be shared. This transparency encourages sharing of information and prevents wasteful duplication of effort while building partnerships with small businesses, universities, California-based national research laboratories, utilities, energy companies and others.

Public energy research is good for California. Public energy research not only powers innovation and technology but also fuels industry leadership and jobs, energy independence and quality of life.

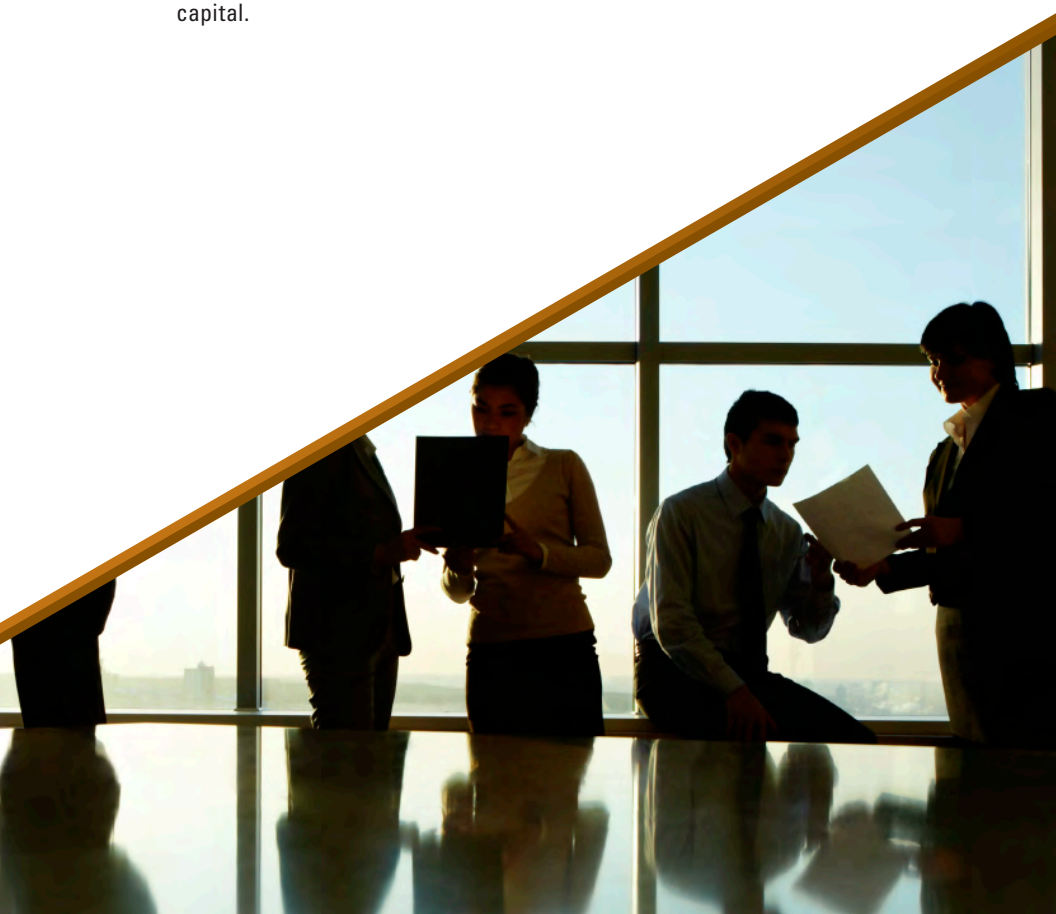
Publicly available research fosters entrepreneurship and furthers innovation

PUBLIC RESEARCH POWERS:

JOBS

In addition to attracting capital, PIER's investments have created jobs. PIER directly supported research jobs and successful research projects that have also led to new companies or new products for existing companies. The Energy Innovations Small Grant program – which accounts for 5 percent of PIER's funding – is estimated to have led to more than 10,000 clean technology jobs and just under 20,000 additional jobs through the economic stimulus effect of these new businesses.

Since the Energy Innovations Small Grant Program accounts for only 5% of PIER funding, the overall PIER program has led to more jobs. In addition, many more jobs will be created as new companies grow and as current PIER research is completed and attracts more capital.



PIER IN ACTION

CLEAN ENERGY SYSTEMS

After receiving start-up funding from PIER, Clean Energy Systems in Rancho Cordova received $30 million in federal stimulus funds to build and test a 150 megawatt zero emission, fuel-flexible power plant. The turbine uses oxy-combustion technology that the company expects to contribute 150 direct jobs and thousands of indirect jobs over the next several years.

SMART GRID FIELD TECHNOLOGY

PIER invested $13.2 million in 15 California-based projects to field test smart grid field technology. The projects received more than $426 million in ARRA funding from the Department of Energy and were estimated to create more than 23,000 jobs in California. These projects will help California add more renewable generation, reduce greenhouse gas emissions, and create a highly skilled, clean technology workforce.

Energy Innovations Small Grant program has led to 10,000 clean technology jobs

PUBLIC RESEARCH POWERS:

INDUSTRY LEADERSHIP

Home to Silicon Valley and other hubs of innovation, California is a leader in science and technology. Research done here attracts the country's brightest minds to our state, but private companies invest in research, development and demonstration (RD&D) to increase profits for their shareholders. They often cannot afford to invest in innovation without certainty about the outcome or the result's future profitability.

California is the leading state in publicly funded, public interest energy research – only New York and Iowa have similar programs, and only New York comes close to the scope of ours. Statistics show that the states with public energy research programs attract four times as much clean technology venture capital funding as states without a research program.

PIER funding can act as "seed money" to attract additional funding to companies undertaking projects to cut energy waste.

PIER IN ACTION

PRIMUS

Primus Power used a $95,000 small grant to parlay a garage-developed technology into a successful venture, garnering an additional $1 million PIER funds leveraged with $14 million in ARRA funds to install a 25 megawatt grid storage system in Modesto, California.

CHA CORP

CHA Corporation developed a system to remove pollutants from generation exhaust and relocated from Wyoming to Sacramento to complete a PIER demonstration project. PIER's $95,000 grant allowed CHA Corporation to partner with SMUD, the Sacramento Municipal Utility District, to demonstrate a microwave technology that removes nitrogen oxides from the exhaust of a biogas engine. This successful demonstration led CHA Corporation to relocate to California.

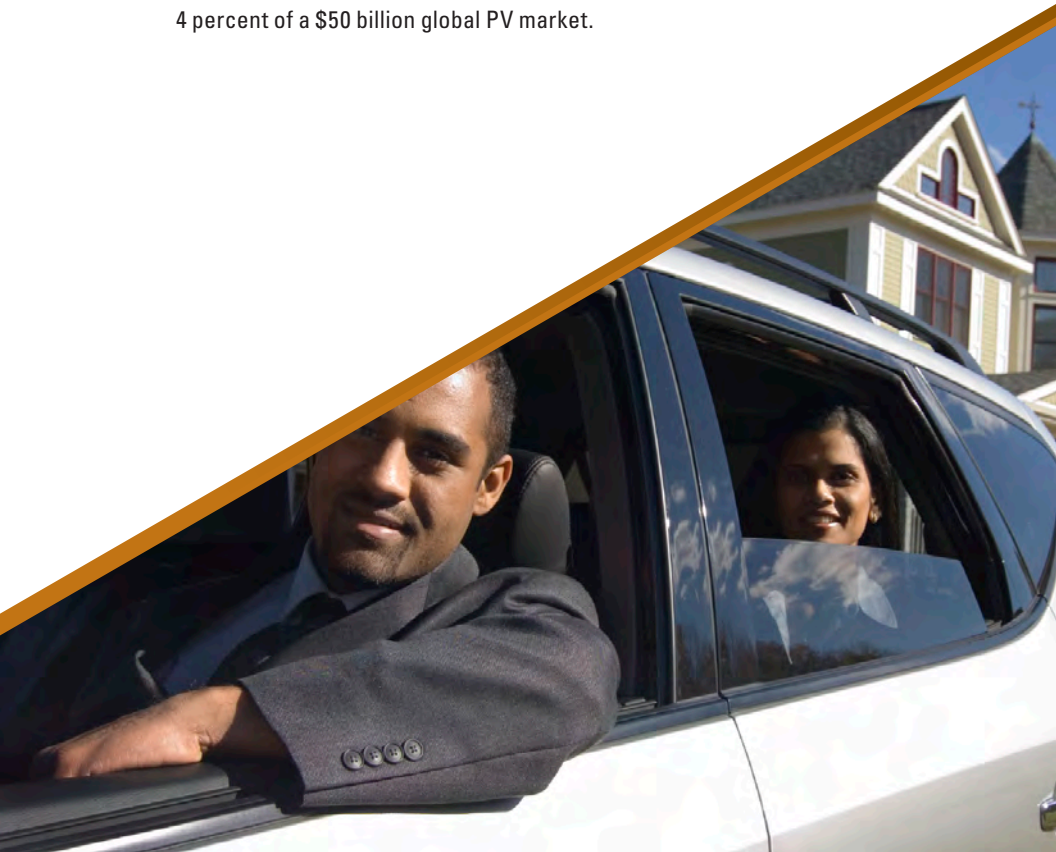
States with public energy research programs attract four times as much clean technology venture capital

PUBLIC RESEARCH POWERS:

ENERGY INDEPENDENCE

California is committed to a broad range of innovative approaches to be sure that a diverse, balanced energy supply remains among the state's primary advantages. Recent world events show how vulnerable we are to the disorder that results from threats to energy supplies or price.

PIER projects are helping transition away from fossil fuels to renewable sources for transportation and electricity generation. A dozen communities statewide are showcasing renewable energy demonstrations – integrating up to 100 percent indigenous renewable resources, including electricity storage, electric vehicles and demand response. PIER has also funded advancements in renewable technology such as integrated photovoltaic roof panels for residential and commercial use. SunPower, a California-based PV manufacturing company, used this research to boost their sales to 4 percent of a $50 billion global PV market.



PIER IN ACTION

GILLS ONIONS

With a $500,000 PIER grant, Oxnard-based Gill's Onions, the nation's largest onion processor constructed a system to produce biogas from onion waste and feed it into two 300-kilowatt fuel cells that produce heat and power. The Advanced Energy Recovery System satisfies about 75 percent of the electricity demands for Gills Onions and conserves almost 112,000 standard cubic feet of natural gas. The technology pays for itself within three to five years, and additional savings come from reducing 150 tons per day of waste onion tops, tails and peels to almost zero. That saves 40,000 gallons of diesel fuel a year from trucks that used to haul the biowaste to landfills, eliminating up to 14,500 tons of carbon dioxide equivalent emissions yearly.

PLUG-IN HYBRID

A PIER-funded project quantified the potential for more fuel-efficient plug-in hybrid electric vehicles to reduce greenhouse gas emissions. The study identified the costs to develop the market and install the required infrastructure; those figures have been accepted as standard and are being used by California's Air Resources Board, utilities, and various auto manufacturers.

PUBLIC RESEARCH POWERS:

QUALITY OF LIFE

Quality of life and the environment are fundamentally intertwined. A degraded environment and a poor economy go hand-in hand. Deterioration of California's richest natural treasures – clean air, water, wildlife habitat and farm land – is a depletion of capital assets that ultimately will be paid for by a lower standards of living and an inferior quality of life.

PIER projects help pave the way to increase Californian's quality of life by targeting technology and products that generate social rather than private benefits, such as advancing environmental stewardship, public health, system reliability and energy security.

Since it began more than a decade ago, PIER projects have resulted in ratepayer benefits from breakthroughs in energy efficiency and renewable energy, energy security and environmental protection. These savings came at a small price to California's utility rate payers – about $2.30 a year for each residential customer, less than the price of a large cup of coffee.

PIER IN ACTION

EFFICIENCY STANDARDS SAVE MONEY

Efficiency standards remain the workhorse for California's impressive energy savings. PIER projects were the catalyst for five new California building and appliance standards that, when fully implemented in 2020, will save the ratepayers nearly $1 billion a year while protecting public health through lower indoor air pollutants, and decreasing energy loads.

SMART GRID IMPROVES RELIABILITY

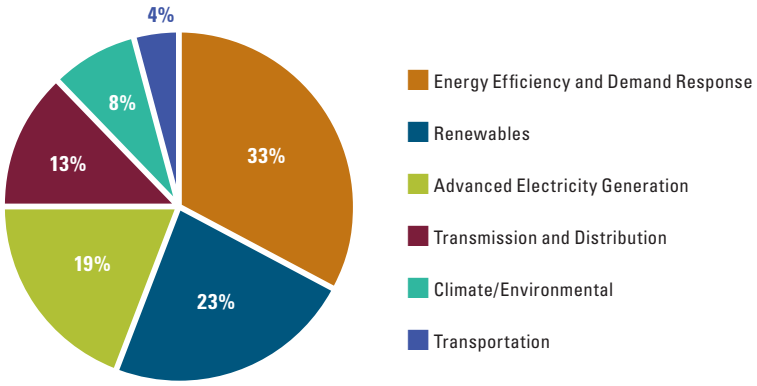
PIER is working with utilities and the California Independent System Operator to develop smart grid technology that addresses problems of generation, transmission, and distribution while meeting the needs of end-use customers. These solutions include advanced communications and controls, intelligent software, and systems designed to avoid rolling blackouts. With minimal cost, these technologies benefit ratepayers by increasing efficiency while improving reliability.

PIER benefits ratepayers through breakthroughs in efficiency, renewable energy, and energy security

PIER FUNDING

California's energy policy establishes a preferred sequence for developing energy resources and infrastructure to meet the state's growing electricity and natural gas needs. This "loading order" of new resources specifies that the first priority is energy efficiency; second, renewable resources; and third, clean fossil fuels sources combined with continuous infrastructure improvements. PIER assures that research priorities and projects are aligned with state goals on energy efficiency, renewable energy and the environment.

PIER RESEARCH CATEGORIES 1997–2010



Solar Cells Efficiency

PIER worked with SF Bay-based Powerlight Corporation (now called the SunPower Corporation) to develop a less expensive photovoltaic tracker system. The resulting PV Tracker increased reliability, lowered costs and reduced installation time compared to earlier designs. It also boosted efficiency of PV systems by 15-35 percent over previous models.

Wireless Data Center

PIER funded a $220,000 project to demonstrate wireless data center controls at the California Franchise Tax Board. As a result, the manufacturer, Federspiel Controls, obtained a $584,000 ARRA grant from the US Department of Energy to demonstrate this technology in 12 data centers throughout California. This project was also supplemented with $330,000 in private match funding.

Redundancy Power Outages

The California Independent System Operator uses advanced power grid monitoring software funded by PIER to increase transmission system reliability and prevent cascading blackouts. Estimated monetary benefits from using the Real-time Display Monitoring System to reduce power outages over a 10-year period, range from tens of millions to over $300 million for California alone, to nearly $1 billion for the entire Western Energy Coordinating Council region (which includes California). In 2009, California ISO acknowledged the value of the system and brought it into its mainstream operation.

Saving Water and Energy

PIER funded research to improve the way water and energy are managed in California's reservoirs. By allowing dam operators to optimize energy generation and water releases over a three year period, the program saved 700 GWh – enough energy to power 100,000 homes for a year – and $42 million in annual electricity costs.

Upgrading Wind Farms

PIER-funded research provided evidence that wind turbines installed on taller towers and carefully placed within a landscape can reduce bird collisions and deaths. This information is being used by wind companies such as NextEra to repower the Altamont Pass Wind Resource area with more efficient turbines leading to more megawatt production per acre. The results are applicable to wind projects around the world.

Natural Gas Engines

Natural gas vehicles emit 30 to 40 percent less greenhouse gas emissions than gasoline- and diesel-powered engines. PIER funded the demonstration of the ISL G natural gas engine in a PG&E service truck that meets the newest federal and state emission requirements. This engine is now commercially available from multiple leading vehicle manufacturers producing trucks, yard tractors, street sweepers, school buses, and shuttle buses. The original equipment manufacturer of the engine has sold more than 400 ISL G powered vehicles in 2009 and 2010.

External Power Supplies

PIER funded the development of a test method that measured the efficiency of external power supplies for items like cell phones and computer chargers. The test method was used by the federal EPA's Energy Star Program as well as by other countries. As a result, new external power supply devices will save Californians an estimated 644 gigawatt/hours (GWh) annually – enough electricity to power approximately 80,000 homes in a year – and save $90.2 million in electricity costs annually.

Efficient Commercial Air Conditioning

PIER financed new ways to cool commercial buildings in California's hot and dry climates, resulting in a 50 percent reduction in electricity use for air conditioning. Newly constructed California WalMart stores are installing radiant cooling systems that use tubes embedded in floor slabs to reduce their air conditioning bills, saving each store about 40,000 kilowatt/hours, or $5,000 each year.

Food Processing

ConAgra Foods demonstrated a PIER-funded, advanced gas-fired drum dryer that increased processing efficiency 25 to 40 percent at their California garlic processing plant. Now commercially available, the technology could save the food processing industry $21 million in annual natural gas costs each year when used to dry fruits, vegetables and other food products.

California Winemaking

California winemakers including Fetzer and Domaine Chandon are using a PIER-funded technology that removes tartrate (crystalline sediments) by passing the wine through membranes, eliminating one of the most energy-intensive processes for a winery. With energy use reduced by 80 percent, electricity costs have dropped from 12 to 16 cents per gallon to about 5 cents per gallon. If adopted by all California wineries, this process could save winemakers about $2.6 million annually.

Research Centers Engage Manufacturers, Academia, Government and Consumers

PIER funded research centers are one of the most cost effective ways to target research on technologies most needed to tackle complex energy challenges. The centers link the energy agency's policy perspective, the universities' know how and industry's connection to California markets. This synergy of industry and manufacturing experts, universities and national labs, government and consumers creates an innovation hub that accelerates emerging technologies into the marketplace. The resources and services provided by the centers are available to the public.

ENERGY INNOVATIONS SMALL GRANT PROGRAM

Not all PIER research is carried out by large corporations or by universities – individuals can have a slice of the PIER investment funds through the Energy Innovations Small Grant Program. Awards are provided up to $95,000 for research to small businesses, non-profits, individuals and academic institutions that show the viability of new, innovative energy concepts. To date, the PIER Energy Innovations Small Grant program has invested about $28 million to stimulate more than 330 demonstration projects resulting in more than a $1 billion in follow-on funding.

Wireless Lighting Control

With PIER support to small business, Adura Technologies developed a wireless lighting control network that creates energy savings up to 70 percent and received $20 million in follow-up venture capital.

Thin Solar Cell

Starting with a $75,000 grant, Nanosolar proved the feasibility of a very thin film solar cell, and built a production plant in San Jose after receiving $500 million in follow-on funding from the private sector. Nanosolar's technology was recognized as the number-one innovation of 2007 by Popular Science and was named one of the top 50 innovations of 2008 by Time Magazine.

Improving Wind Turbines

Dehlsen Associates, LLC (now ClipperWind) demonstrated a PIER-funded, distributed generation drive train for wind turbines. In 2010, a Connecticut-based firm, United Technology Corporation (UTC), one of the world's leading industrial technology companies, purchased a 49.5 percent stake in Clipperwind, infusing them with $206 million in capital investment. UTC bought the remaining shares of Clipperwind for $112 million.

RESEARCH POWERS CALIFORNIA

The public interest energy research supported by PIER has wide ranging benefits beyond technology and innovation. RD&D touches every part of life in California, from jobs created to money saved on energy costs to environmental improvements that affect the quality of life of our citizens.

Research provides …

- **JOBS** that prepare Californians for the greener 21st century.
- **LEADERSHIP** that fosters entrepreneurship and brings some of the smartest minds in the country to our state.
- **INDEPENDENCE** from energy shortages and cost spikes that can hamper the economy.
- **A BETTER QUALITY OF LIFE**, as new, more efficient technology brings lower energy costs and reduces air and water pollution for us all.

"Every new product – from software to widgets – goes through a cycle that begins with basic research, then applied research, then incubation, then support, then continuation engineering to add improvements. Each of these phases is specialized and unique..."

–Thomas Friedman, The World is Flat

Edmund G. Brown Jr.
Governor

Robert B. Weisenmiller, Ph.D.
Chair

James D. Boyd,
Vice Chair

Commissioners:
Karen Douglas
Carla Peterman

CALIFORNIA
ENERGY COMMISSION

JULY 2011
CEC–500–2011–030–BR